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Published in:
EPRINTS-BOOK-TITLE

Publication date:
2003

International Conference on Network Universities and e-Learning. 8-9 May 2003. Valencia. Spain.
http://www.hsh.no/menu/

Designing an e-Learning Objects Brokerage System

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ABSTRACT

E-Learning Objects Brokerage Systems are considered as the state-of-the-art in systems that facilitate the exchange of learning objects. These systems currently exist and operate at a limited scale but their use is vastly increasing, especially in multi-party educational organizations, such as virtual universities. This paper performs a study of existing e-Learning Objects Brokerage Systems, and specifies the ideal requirements for such a system. It also proposes a distributed architecture that would enable the interoperation between different e-Learning Objects Brokerage Systems.

Keywords

Brokerage system, learning object, digital repository, broker, e-learning, distributed system, task analysis, use cases, virtual university.

1. INTRODUCTION

The Web puts a huge number of learning resources within reach of anyone with Internet access. In most cases, these valuable resources are difficult for most educational stakeholders to locate efficiently and effectively. This is why e-Learning Objects Brokerage Systems (LOBS) have emerged. In very generic terms, an online "**brokerage system**" is an on-line entity that acts as an electronic marketplace. A brokerage system has two types of users: those who offer their products for sale (*providers*) and those who buy the products offered (*consumers*). An e-learning objects brokerage system facilitates the exchange of learning objects among organizations and individuals.

The term **learning object** is not intended to be restrictive but refers to any digital asset which can be used to enable teaching or learning [IEEE 2001]. Neither does a learning object imply some specific size or modularity. It may refer to many different types of object from simple images or video clips, through complex questions, to collections of objects arranged in one or more sequences. One critical issue about learning objects, concerns the ability of their administration, in terms of updating, identifying, utilizing, sharing and re-using them, which remains a great challenge, as their number continues to grow at a fast rate. The only viable solution proposed to this problem, is to define a set of metadata on them, that is, a set of attributes required to fully and adequately describe them [IEEE 2001]. There are several, highly active, standardization initiatives today that are concerned with the definition of specifications for learning resources metadata.

E-Learning Objects Brokerage Systems usually offer learning objects stored in **digital repositories**. While digital repositories, in the broadest sense, are used to store any digital material, digital repositories for learning objects are considerably more complex both in terms of what needs to be stored and of how it may be delivered [Duncan 2002]. Digital repositories are not mere portals, i.e. gates of access to learning material. What makes a digital repository much more than a portal is the ability to discover a learning object and put it to a new use. The purpose of a digital repository is not simply safe storage and delivery but reuse and sharing. In a few cases, LOBS contain digital repositories, but this is not always the case.

An important aspect of LOBS is the categories of users that benefit from them, by performing certain usage scenarios. Users of digital repositories are mostly educators and in general, authors of learning content. They may produce web-based courses or classroom courses, face-to-face or distance-learning, full courses or short digital "nuggets". The e-Learning Objects Brokerage System should be neutral to the pedagogic purposes of the material just as a library has no influence over where or when a book is read

LOBS are particularly fit to be used in the context of multi-party, distributed organizations, such as Virtual Universities. These organizations are comprised of smaller constituents, such as partner-institutes in several Universities, possibly from different countries, and each such institute must deliver courses in joint programs of study. Subsequently there is a need to seamlessly offer courses from several institutes to the students who are possibly located themselves in different countries through a unified interface. In this case e-Learning Objects Brokerage Systems are commissioned with the responsibility to do exactly that: provide services for partner institutes that offer courses, as well as students that wish to attend courses in a integrated and seamless fashion.

The aim of this paper is to present the requirements of an ideal e-Learning Objects Brokerage System that will provide services, covering the aforementioned critical issues. We will also describe how this system could be de-centralized, i.e. distributed, which is the main difference from all the systems that exist today in the WWW. Peer to Peer (P2P) based approaches are more flexible than centralized approaches, bearing several advantages. In this case, content consumers, both teachers and students, can benefit from having access not only to a local repository, but to a whole network, making queries on metadata of distributed learning objects [Nejdl et al., 2002].

The structure of this paper is as follows: We start by describing the set of LOBS under evaluation. We then move on to describe the approach we have followed for locating the functionality offered by these systems. This investigation leads to the extraction

of the tasks and the requirements that an ideal e-Learning Objects Brokerage System should perform, by presenting typical task analysis and use case diagrams. This is followed by a proposal of a novel de-centralized architecture for e-Learning Objects Brokerage Systems. The paper brings to a close with some conclusions and future work.

2. LITERATURE REVIEW

In this section, we present the sample set of e-Learning Objects Brokerage Systems that operate in the WWW. We briefly describe the goals of each system, as these appear in the "About us" section of each system.

Universal Brokerage Platform for Learning Resources (UDP): The Universal Brokerage Platform (http://www.ist-universal.org/) is a web-based platform, which supports the creation and sharing of knowledge. It enables collaboration among educators by providing a full range of services to support the exchange of Learning Resources. The UBP provides functionality for cataloguing and delivering both educational materials, which refer to sharable chunks of reusable learning content (electronic textbooks, recorded lectures and presentations, case studies, quizzes, lecture notes, problem statements, project assignments, etc.) and educational activities, which refer to distributed educational and training activities (lectures, tutoring sessions, synchronous group collaboration, complete on-line courses, etc).

World Lecture Hall: World Lecture Hall (http://www.utexas.edu/world/lecture/) publishes links to pages created by faculty worldwide who are using the Web to deliver course materials in any language. Some courses are delivered entirely over the Internet. Others are designed for students in residence. Many fall somewhere in between. In all cases, they can be visited by anyone interested in courseware on the Internet i.e. faculty, developers, and curious students alike.

The Globwide Network Academy: The Globewide Network Academy (http://www.gnacademy.org/) is dedicated to promoting access to educational opportunities for anybody, anywhere. To do this, GNA pioneers and develops distance learning relationships and facilities for the worldwide public to use. GNA provides links to hundreds of distance learning courses that users can take advantage of.

Element K: At Element K (http://www.elementk.com/), they have more than 20 years of solid experience in the education and training market. They understand what it takes for students to learn. Moreover, they know that everyone is different. Therefore, they created an e-Learning solution that addresses different styles, paces, and preferences. The e-Learning solution they offer has three key ingredients: best-in-class content, a state-of-the-art learning management system (LMS), and responsive, knowledgeable service.

Online Learning Network: As the leading online supplier of continuing higher education, OnlineLearning.net (http://www.onlinelearning.net/) provides busy professionals with the tools to pursue their lifelong learning objectives. By combining technological innovation with extraordinary customer service, the company is committed to bringing the best in educational resources to adult learners around the world, anytime, anywhere, at any stage in life. OnlineLearning.net has accepted more than 20,000 enrollments in 1,700 online courses since 1996.

Digital Think: DigitalThink (http://www.digitalthink.com/) is focused on helping organizations use learning to get the business results that they want and need. DigitalThink's primary focus is e-learning business solutions that are 100 percent Web-based, offering instant, global deployment and access, quick and easy updates, and minimal IT infrastructure and resource demands for our customers. DigitalThink also offers other courseware delivery options, including via corporate intranets.

McGraw-Hill Learning Network (MHLN): MHLN (http://www.mhln.com/) is dedicated to educating children and to helping educational professionals by providing the highest quality materials and services. On mhln.com, teachers can set up a free online classroom to communicate with students and parents. Teachers can take advantage of many free McGraw-Hill online resources, or they can purchase a subscription to online content such as interactive textbooks. The students can go to an online class, get homework help, and play games. Class tools, activities, and online content are available for free. The parents can visit their child's online classroom, view progress reports, and take advantage of many free McGraw-Hill online resources, all for free. Parents can also purchase a subscription to online content such as interactive textbooks.

SeSDL: The SeSDL (http://www.sesdl.scotcit.ac.uk/) is a web-based resource center designed to encourage the sharing and reuse of development materials. The main focus of the materials is the use of communications and information technology (C&IT) in teaching and learning but other topics will also be included. The resource center concentrates on materials, which can be delivered via the web and so can be used in a number of different flexible approaches to staff development.

IntraLibrary: IntraLibrary (http://www.intrallect.com/) is a digital repository for learning objects. It enables groups of trainers and content authors to store, share and re-use learning resources using a simple, web-based interface. IntraLibrary encourages content creators, such as university teaching staff or corporate training staff, to granularise their learning content into lots of smaller learning objects.

HEAL: HEAL's (http://www.healcentral.org/) primary mission is to provide educators with high-quality and free multimedia materials (such as images and videos) to augment health science education. In addition, HEAL is working with other organizations to establish a network of distributed databases of high-quality teaching resources. By using state-of-the-art Internet technologies HEAL enables educators across the country to efficiently search and retrieve teaching materials from a variety of sources.

COLIS (EdNA): EdNA Online (http://www.edna.edu.au/go/browse/0/) is a service that aims to support and promote the benefits of the Internet for learning, education and training in Australia. It is organized around Australian curriculum, its tools are free to Australian educators, and it is funded by the bodies responsible for education provision in Australia - all Australian governments. As an information service, EdNA Online provides two key functions: a directory about education and training in Australia and a database of web-based resources useful for teaching and learning. As a communications service, EdNA Online aims to promote collaboration and cooperation throughout

the Australian education and training sector and facilitate the growth of networks of common interest and practice.

BELLE/ CAREO: CAREO (http://careo.netera.ca/) is a project supported by Alberta Learning and CANARIE that has as its primary goal the creation of a searchable, Web-based collection of multidisciplinary teaching materials for educators across the province and beyond.

MERLOT: MERLOT (http://www.merlot.org/) is a free and open resource center designed primarily for faculty and students of higher education. Links to online learning materials are collected along with annotations such as peer reviews and assignments. MERLOT is also a community of people who are involved in education. Community members help MERLOT grow by contributing materials and adding assignments and comments. Many community members make their professional information available in MERLOT's member directory.

SMETE: SMETE.ORG (http://www.smete.org/) serves as an integrative organization and distributes pedagogical material through the establishment of a federation of digital libraries. Providing direct access and delivery of instructional resources, the SMETE Open Federation advances education through participatory communities of learners.

LearnBerta Portal: The goal of the LearnAlberta.ca (http://www.learnalberta.ca/) project is to support lifelong learning by providing students, parents, teachers and others in the Kindergarten to Grade 12 (K-12) community with access to learning resources via the LearnAlberta.ca portal. These learning resources will be in the form of multimedia learning objects that directly relate to the Alberta programs of studies and will be made accessible anywhere, anytime via linked databases and portals on the Internet.

3. SYSTEM REQUIREMENTS FOR AN IDEAL SYSTEM

In this section we focus on the requirements that an e-Learning Objects Brokerage System must satisfy. The requirements are grouped in tasks that the system has to perform. The type of task analysis we have chosen is hierarchical and borrows ideas from several sources, including [Wigley 1985]. In a hierarchical task analysis, each task is analyzed by “breaking it into task elements or goals which become increasingly detailed as the hierarchy progresses” [Stammers et rd., 1990]. The most general information is placed at the top of the hierarchy, with the more specific information following on lower levels. Some figures that show part of the task analysis can be found in subsection 3.1.

The major tasks that LOBS perform are:

1. Browse catalogue of resources
2. Search resources
3. View resource details
4. Reserve details
5. Manage reserved resource
6. Buy resource (payment)
7. Resource delivery
8. Contribute resource
9. Manage contributed resources
10. Annotate resource
11. Personal user account
12. Update notification
13. System informative material
14. Company informative material
15. Contact system personnel
16. Multilanguage support
17. Specialized features

Table 1, that follows at the end of the paper, summarizes the functionality of all the LOBS, presented in Section 2 and gives a comparative view. In Table 1, if a system performs a certain task, it is given a value of 1, otherwise it is given a value of 0. In the same table, there is a column that illustrates the percentage of systems that perform each task.

It is evident that every system should provide some way of *browsing and searching for the offered resources*. It is cleared that a simple text search is not sufficient and some sorting of the search results should be available. Therefore, we propose that an ideal e-Learning Objects Brokerage System implements the following two general tasks: "Browse catalog of resources" and "Search resources". Browsing should concern all resources on a specific (easily selected) area / category. As for searching, in addition to the simple text search, an advanced and customized search option should be also available. The results should be presented, after being sorted, either alphabetically, by relevance, by category, by last update or by any other meta-data information available for the resources.

When *viewing the details* of a selected resource, it is useful for the user to view, in addition to the meta-data available for the resource, some other indicative information. This includes some sample material or a summary / abstract of the resource, depending on each case. Users also seem to find useful comments and ratings by other users that have used the same resource. The e-learning objects brokerage system should also offer cross-reference to other resources that were also used by users of a given resource. This seems to provide the user with a very focused and high relevancy search option as illustrated by sites like "Amazon" and "Google" (with the option "Find similar pages").

In the case that an e-learning objects brokerage system requires some form of *resource reservation* (as in brokerage platforms or providers of e-learning content), the system should provide the user with the option to view the "license agreement" under which the reservation (or buying) of resources takes place, at any time (before, during or after the reservation takes place). The "license agreement" can be either specific to each resource (as in brokerage platforms, where resources have different providers) or common to all resources (as in providers of e-learning content, where the provider offers all resources). The user should have the "Reserve resource" option available, without being forced to commit to his/her choice, until the user is ready to proceed to the next step (resource delivery or payment).

Except for reserving a resource, the user should be also able to somehow *manage the reserved resources*. This option is not limited to viewing the resources reserved during the user's last transaction, but may (preferably) include all the reservations (that were actually committed) by the user in the past. This allows the user to manipulate this list by designating his/her favorite resources, recommend a resource for other users, rate a resource and comment (on usefulness, relevance to some topic, or any other useful criterion). The user can also categorize the resources to custom categories and manage the resources (actually links to

the resources). This includes canceling an already reserved resource, or committing to the reservation (at which time the resource's provider should be notified and not prior to that time).

The option to *buy a resource* is critical in e-learning systems that "sell" e-learning content online. Although the payment stage of a transaction can be carried out via alternative offline methods (e.g. telephone or mail order), we feel that since the rest of the transaction is completed online, so must the payment stage. The subtasks for implementing this requirement are well known and need not to be discussed here. We should note, however, that the payment stage should be in accordance with the reservation of resources and the commitment requirement as explained above. Hence, the user should be allowed to reserve and cancel the reservation for any number of resources before committing and paying for them.

Regarding the *delivery of resources*, this can be implemented depending on the resource type, system category, terms of resource sharing (e.g. use once, unlimited use) and its digital rights, in general. This could include presenting the e-learning material onscreen, downloading the material to a local media or linking to a web site. In case an e-Learning Brokerage System contains a digital repository, it will be able to provide access to the e-learning content by itself. In any other case, it should provide just access details which should have been already given by the content provider as an addition to the standard learning object meta-data.

Complementary to the resource delivery is the option to *contribute a resource*. This is not required by all LOBS, but is necessary for digital repositories. When contributing a resource, the user should be able to either provide a link to the resource or upload the material to the system server, according to the desired functionality of the system. In any case, the user should be able to clearly define the intended viewers of the resource and the conditions under which the resource may be used, i.e. the digital rights. The system is responsible to uphold any constraints defined on the resources, provided that these comply with the system's policy.

An assistant functionality to contributing a resource is the "*Manage contributed resources*" feature. In addition to viewing the resources contributed by a user-provider, the user should have the option to edit a contributed resource, or even cancel a contribution and withdraw the resource, again given that this complies with the system's policy. Lastly, the user has the option to make a contribution public and thus commit to his/her contribution.

The user should be provided with an option to *annotate a resource*, and store the annotations in an annotation repository. The user should be able to comment on the resource, using either free text or specific notations, e.g. “star system” for rating the quality of the resource. There should be an authentication mechanism for each user since there can be two kinds of annotations: the private and the public ones. Each annotation object should be accompanied by meta-data specifying the author, timestamp, the kind (e.g. “criticism”, “praise” etc.). Additionally, other relevant sub-tasks are to filter and retrieve annotation sets based on their metadata.

The option to create a *personal user account* is almost a necessity in e-learning objects brokerage systems. This allows the system to keep personal user information (e.g. the reserved resources), to contact the user for updates and to adjust to each user's individual needs. The latter is important in order to provide a personalized and thus efficient and focused use of the system, since each user has unique expectations from the system.

Regarding the "*Update notification*" option, this should be provided upon user's request only and the user should be able to terminate it at any time. The information provided should be relevant to the user as possible, something that can be achieved by utilizing the user's personal preferences. The notification should be made both online (e.g. in the home page or some specific news page) and via email (e.g. mailing list or newsletter), according to the user's request.

An important feature of any system is to provide *informative material about the system*. This material can and should take many different forms, including manual, FAQ, site map and glossary. The user should have the option to select the form with which he/she feels most comfortable with and believes it can most efficiently and accurately provide the needed information. It is also important that the information is presented modularly starting from help on the basic system functionality and moving to the more advanced functionality upon user request. Lists of steps that guide the user should be used whenever possible, instead of plain text.

The systems should also provide *company informative material*, that although not directly related to the system itself, may provide useful information to some users. This information should be clearly marked and accessible, but should not interfere with the system's functionality and documentation. The latter will result in confusing the user and blurring the system's indented goals and capabilities.

Besides reading precompiled help material, the system should also provide an option to *contact the system personnel*. The user should have the option to contact (via email, phone or online live chat, according to the importance of the request) the system personnel and get answers to specific questions or provide feedback about the system. Support and feedback should be preferably implemented via form completion. The structured input guides the user and allows for better processing of he information.

The *multilanguage support* feature should be considered amongst the most important features of an e-learning system. A system that provides e-learning content should be able to also address the needs of foreign users that may not master the language of the system. This of course is not limited to providing multilanguage resources, which is of course equally important. The entire system documentation and online information (except contributed resources) should be able to be translated to other languages. A clearly marked way should be provided to toggle between languages, appearing (preferably) on the home page (or every page) through icons (e.g. country flags).

The above cover the basic requirements of e-learning systems. In addition, some s*pecialized features* may also be present, depending on the system's goals. Such features include discussion forums, glossaries, etc. Although these features are not considered to be essential, when implemented and integrated correctly they can advance a system's overall image.

3.1 Task Analysis

Task analysis is a study of actions and/or cognitive processes that a user is required to do, in order to achieve a task. It gives an understanding of the current system and how information flows within it. In this section, we present indicative examples of how some tasks of an ideal e-Learning Objects Brokerage System can be analyzed.

Initially, we give an overview of the main tasks of the system. In Figure 1, we present the approach that a registered user (or a user that intends to register) should follow in order to take advantage of the whole system functionality. On the contrary, in Figure 2 we present the approach of a non-registered user. Figure 1 and Figure 2 should be considered as the two alternative actions for the general system process task.

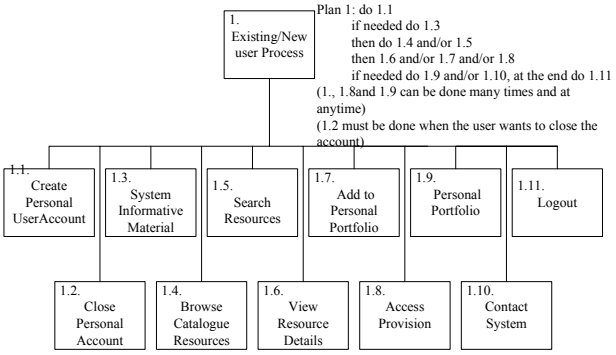

Figure 1: System process for a registered user

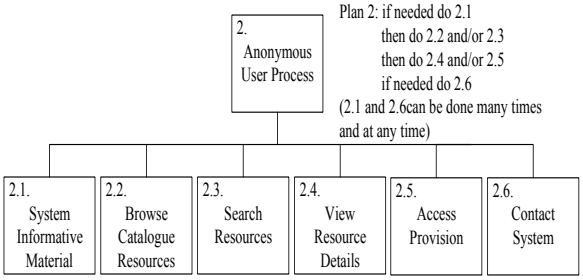

Figure 2: System process for a non-registered user

Figure 3 depicts the analysis of the "Search resources" task. As we have already described, either a simple text search or an advanced search form will accomplish the searching of the requested learning resources.

During action 3.1, the user, registered or not, fills in the search form. The most significant fields that a search form should contain are the scientific category, the subject, the language, and the access type of the resource, the last modification or updating date, the author or the publisher if the resource concerns articles.
The result of this task will be the presentation of a result list. For each result, the user will be able to choose amongst three others tasks, the "View Resource Details", the "Access Provision" and the "Personal Portfolio".

One more example of a task analysis concerns the "Personal User Account" task, depicted in Figure 4. A registered user can log on to the system and a new user can create his/her personal account.

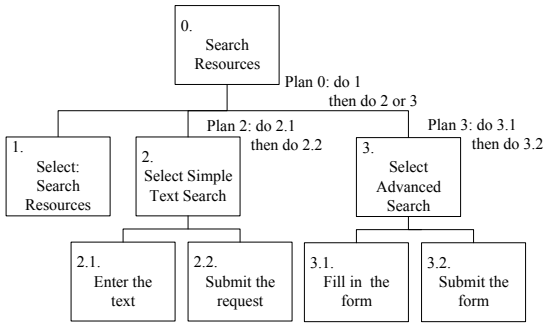

Figure 3: "Search resources" analysis

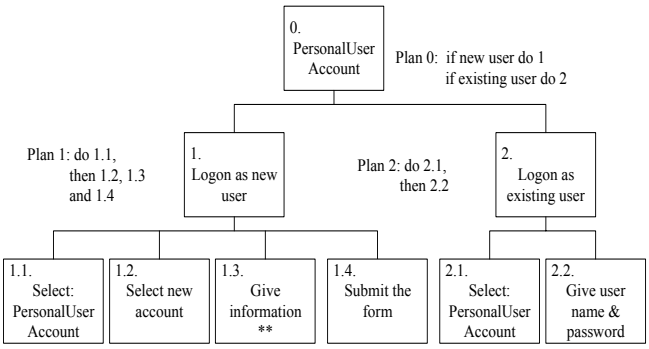

Figure 4: "Personal User Account" analysis

3.2 Use Case Diagrams

Use case diagrams can be used to describe the functionality of a system. Rather than merely representing the details of individual features of a system, use case diagrams can be used to show all of its available functionality. Use case diagram show the relationships between external actors and use cases in a system.

In this subsection, we present some examples of use case diagrams. These diagrams combined with the task analysis we have described in the previous subsection, illustrate a significant part of the functionality of an ideal e-Learning Objects Brokerage System.

Similarly with the task analysis subsection, the first use case diagram given, contains the main use cases of the system operation. We give two different approaches (Figure 5 and Figure 6) for a registered and a non-registered user respectively.

Figure 7 depicts the use case diagram that describes how a registered user can search for learning resources. Figure 8 presents the way that a user can access a learning resource that is presented in a result list.

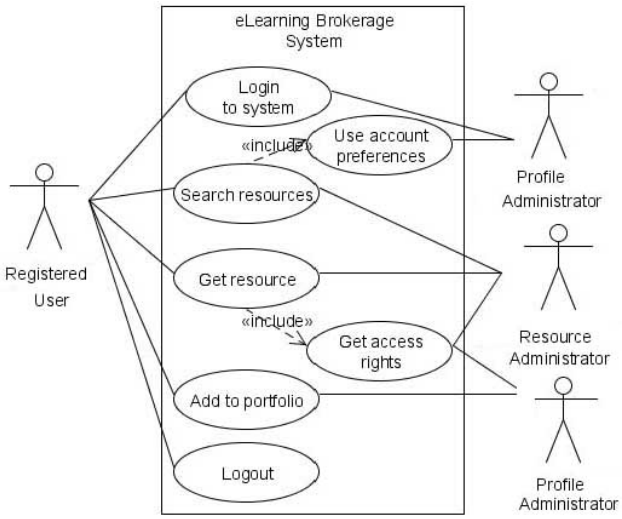

Figure 5: System process for a registered user

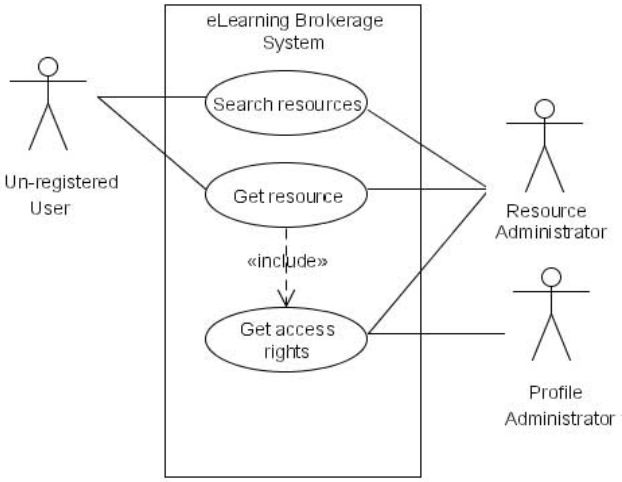

Figure 6: System process for a non-registered user

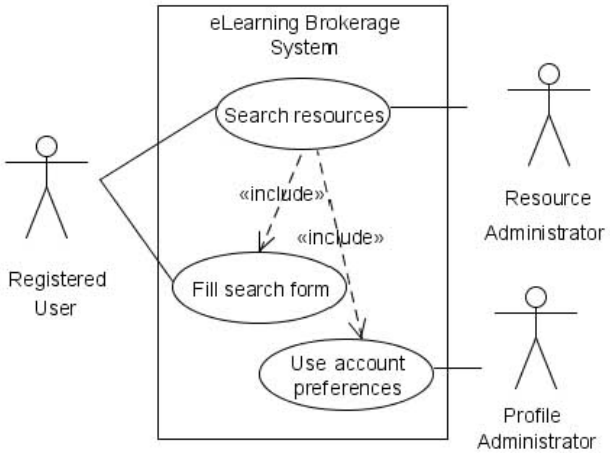

Figure 7: Search resources from a registered user

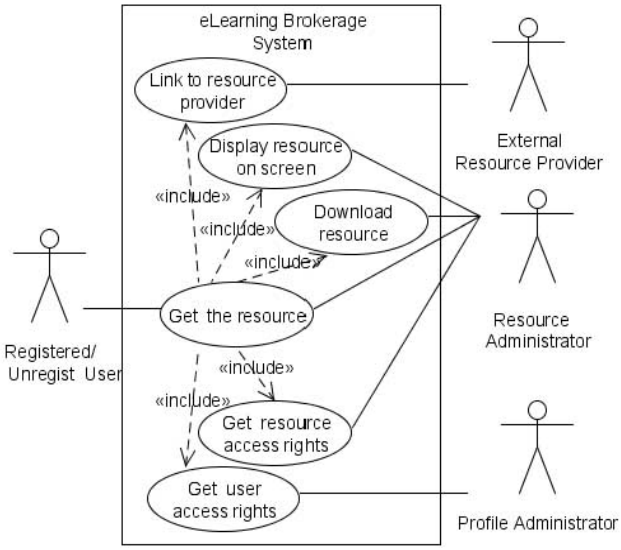

Figure 8: Access to a learning resource that is returned in a result list

4. DESIGNING AN IDEAL DECENTRALISED SYSTEM

At this point, we have defined all the requirements that an ideal e-learning objects brokerage system should satisfy. In addition to the above general tasks, the ideal brokerage system should provide some special features that will distinguish it from all the other systems. These new features are based on the paradigm of distributed computing. Most of the existing LOBS are based on a centralized, non-distributed architecture. All the offered learning resources can be found in a central repository of data that the broker has access to. Our proposal is an architecture of distributed data repositories. Apart from a central data repository where the broker can find its own learning resources, several other data repositories located in different places in the Internet can connect to such a decentralized brokerage system.

In particular, each e-Learning Objects Brokerage System or any other independent data repository can register to this brokerage

system. Whenever a user performs a request to the broker for specific learning resources, the broker will search both in its digital repository and also communicate with the external brokerage systems or digital repositories. The communication with the other systems can be performed via designated interfaces, which can import and export the metadata of their learning resources. The exchange of metadata can be accomplished through a descriptive and extensive language such as XML. Importing the XML representation of metadata, the broker can be informed about the kinds of learning resources that other systems possess.

The broker needs to know only the metadata of each external system ignoring the structure of each repository. All external systems should only provide their metadata representation in a uniform manner that the broker understands. Following this design principle, the brokerage system can be characterized from an open architecture where various and different structured systems and repositories that offer learning resources can communicate. Figure 9 illustrates an overview of the design of a decentralized e-Learning Objects Brokerage System.

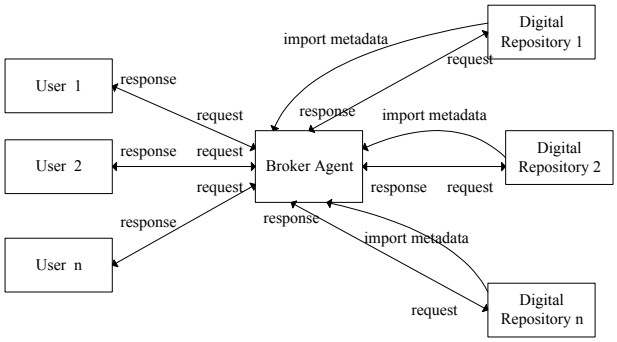

Figure 9: Overview of the design of a decentralized e-Learning Objects Brokerage System

5. CONCLUSION

In this paper, we have studied e-Learning Objects Brokerage Systems and we have focused on the requirements that an ideal e-Learning Objects Brokerage System must satisfy. Comparing the existing systems, we have concluded that the standalone, isolated architecture is insufficient, while a decentralized architecture would be the ideal case.

Our main objective for the future is the implementation of a prototype, which has already started, that satisfies all the requirements we have discussed, and the establishment of our system as an innovated distributed e-Learning Objects Brokerage System. Our vision is closely related to the vision of the Edutella project which focused on a P2P network for the exchange of educational resources. Close collaboration will be attempted with the Edutella consortium as well as other consortia like Ariadne and the CEN/ISSS Learning Technologies workshop.

6. ACKNOWLEDGMENTS

The authors would like to acknowledge the support of the European Commission through grants HPRI-CT-1999-00026 (the TRACS Programme at EPCC) and NO001ELEARN011 (the e-Learning Programme).

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PLATFORMS / TASKS	Stats	UBP	WLH	GNA	EL.K	OLn	Dig.Th	McGr	SeSDL	IntL	Heal	Colis	Careo	Merlot	Smete	LearnA.
Browse catalog of learn. objects	93%	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1
View catalog of learn.objects	80%	1	0	1	1	1	1	1	1	1	0	1	1	1	1	0
Browse learn. objects by area/category	93%	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1
Search learning objects	93%	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1
Simple text search	93%	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1
Advanced search	80%	1	1	0	1	0	0	1	1	1	1	1	1	1	1	1
Customized query search	7%	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sort results	47%	1	1	0	0	0	0	1	1	1	0	0	0	1	1	0
View learning object details	100%	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
View learning object meta-data	100%	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
View comments, reviews and ratings	20%	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0
View cross-referenced learning objects	13%	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0
Reserve learning object	47%	1	0	0	1	0	0	0	1	1	1	0	1	0	0	1
Agree with license agreement	13%	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Book learning object	33%	1	0	0	0	0	0	0	1	1	1	0	1	0	0	0
Add to shopping cart	13%	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Manage reserved learning objects	67%	1	1	0	1	0	0	0	1	1	1	0	1	1	1	1
View list of booked learning objects	33%	1	0	0	0	0	0	0	1	1	1	0	1	0	0	0
View shopping cart	13%	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Commit reservation	27%	0	0	0	0	0	0	0	1	1	1	0	0	0	0	1
View history of all reserved learn. objects	40%	1	0	0	1	0	0	0	1	1	0	0	1	0	0	1
Categorize learn. objects (e.g. favorites)	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Comment, review or rate a learn. object	20%	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0
Buy learning object (Payment)	27%	0	0	0	1	1	1	0	0	0	0	0	0	0	0	1
Learning object delivery	100%	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Connect to system server	60%	1	0	0	1	0	1	1	1	1	1	0	1	0	1	0
Connect to another site (provider)	60%	1	1	1	1	1	0	0	0	0	0	1	1	1	1	0
Send to customer (via mail)	13%	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Contribute learning object	60%	1	1	1	0	0	0	1	1	1	0	1	1	1	0	0
Upload to system server	27%	1	0	0	0	0	0	1	1	1	0	0	0	0	0	0
Provide link to another site	47%	1	1	1	0	0	0	1	0	0	0	1	1	1	0	0
Define terms (license agreement)	20%	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0
Manage contributed learning objects	47%	1	0	1	0	0	0	1	1	1	0	0	1	1	0	0
View list of contributed learning objects	40%	1	0	0	0	0	0	1	1	1	0	0	1	1	0	0
Edit / cancel contributed learning object	47%	1	0	1	0	0	0	1	1	1	0	0	1	1	0	0
Commit contribution (make available)	27%	0	0	0	0	0	0	0	1	1	0	0	1	1	0	0
Personal user account	80%	1	0	0	1	1	1	1	1	1	1	0	1	1	1	1
User profile and preferences	80%	1	0	0	1	1	1	1	1	1	1	0	1	1	1	1
My library / portofolio of learning objects	60%	1	0	0	1	1	0	1	1	1	1	0	1	1	0	0
Site personalization	7%	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0

Update notification	80%	1	0	1	1	1	1	1	0	0	1	1	1	1	1	1
Mailing list	20%	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0
Newsletter	33%	0	0	0	1	0	1	1	0	0	0	1	0	0	0	1
What´s new / Upcoming updates	60%	1	0	1	0	0	0	1	0	0	1	1	1	1	1	1
System informative material	100%	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Help manual	73%	1	0	0	0	0	1	1	1	1	1	1	1	1	1	1
F.A.Q.	73%	1	1	1	1	1	1	1	0	0	0	1	1	1	0	1
Site map	53%	0	1	0	1	1	1	0	0	0	1	1	0	1	0	1
Terms of use	73%	1	0	1	1	1	1	1	1	1	0	1	0	0	1	1
Glossary (of technical terms)	20%	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1
Company informative material	100%	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Company profile (About us)	100%	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Partners and alliances	87%	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1
News and events/Calendar	67%	0	0	1	1	1	1	0	1	1	0	1	0	1	1	1
Contact system personnel	100%	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Email (Contact us)	100%	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Support request form	13%	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
Provide feedback form	40%	1	0	0	1	1	0	0	0	0	1	1	0	0	0	1
Multilanguage support	73%	1	1	0	1	0	1	1	1	1	0	1	1	1	0	1
Multilanguage learning objects	67%	1	1	0	1	0	0	1	1	1	0	1	1	1	0	1
Multilanguage system	13%	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Specialized features	53%	0	0	1	1	1	1	1	0	0	0	1	0	0	1	1
Discussion forum	33%	0	0	1	1	1	0	0	0	0	0	1	0	0	1	0
Advising services	13%	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Educational tools/other material	33%	0	0	1	1	0	0	1	0	0	0	1	0	0	0	1

Table 1: Comparing Brokerage System Tasks